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INTELLIGENCE MEMORANDUM

TITANIUM IN THE SINO-SOVIET BLOC

CIA/RR IM-443

31 December 1956

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FOREWORD

Reflecting Soviet policy regarding all nonferrous metals, the USSR has released few data on titanium. In June 1947 the Council of Ministers of the USSR declared that information on reserves and extraction of all nonferrous metals was "a state secret, the divulgence of which is punishable by law." This policy actually had been effective since the mid-1930's. The result is that the USSR (and the European Satellites as well) has released no direct information on the status of the titanium industry in the Sino-Soviet Bloc. Only recently, in fact, has the USSR permitted publication of scientific and technical articles on titanium. The Soviet writers have carefully avoided reference to the quantities of titanium raw materials, concentrates, or metal produced; the location of plants; or the extent of application in the aircraft industry or in other military production.

Under these conditions, assessment of the current status of the Soviet titanium industry is most difficult. All available information, from books and articles published in the Russian language and from intelligence sources, has been analyzed. Although the estimates and conclusions presented in this memorandum are believed to be reasonable, they necessarily have been derived by inference.

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TITANIUM IN THE SINO-SOVIET BLOC*

Summary and Conclusions

Production of titanium sponge in the Sino-Soviet Bloc in 1956 is estimated to have been between 3,000 and 5,000 metric tons,** which at the maximum was about one-third as much as was produced in the Free World and 40 percent as much as was produced in the US. For all practical purposes the Bloc production of titanium is confined to the USSR. Although East Germany, Hungary, Czechoslovakia, Poland, and Communist China are known to be interested in the development of titanium and have done experimental work, production has been limited to laboratory-scale quantities.

The USSR is the only country in the Sino-Soviet Bloc that has adequate natural resources for supporting the development of a large-scale titanium industry. Although Soviet resources of rutile, the only low-cost titanium-bearing ore, are negligible, Soviet reserves of ilmenite, a titaniferous magnetite containing 10 to 15 percent titanium dioxide, are enormous. There are major deposits of ilmenite in the Ural Mountains and the Kola Peninsula.

Soviet scientific and technical books and articles published in the Russian language disclose a high degree of interest in titanium. These sources also indicate that the USSR is acquiring the technical experience necessary to the development of an integrated titanium industry. Soviet scientists have been assisted greatly by the theoretical and engineering details of Free World research on and development of titanium and titanium base alloys. They are familiar, for example, with vacuum melting procedures and both magnesium and sodium reduction processes, and they understand the consumable electrode and double melting techniques. Published Soviet material indicates, however, that the titanium industry of the Bloc is from 2 to 4 years behind the US industry.

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* The estimates and conclusions contained in this memorandum represent the best judgment of ORR as of 31 December 1956.
** Tonnages throughout this memorandum are given in metric tons.

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Although the USSR has shown strong interest in all aspects of titanium and is carrying on a large research and development program, it does not appear to be trying to match the growth of titanium production and utilization in the US. Available evidence suggests that Soviet metallurgists hold some reservations regarding the necessity for titanium in aircraft. Comparison of titanium base alloys with special steels, on both a strength-to-weight basis and a cost basis, may be responsible, at least in part, for the "wait and see" attitude of the USSR.

The USSR also is alert to the nonmilitary application of titanium. It is unlikely, however, that the less strategic uses will be of sufficient importance to the Soviet planners to alter the normal course of events in budget allocations. It is to be expected, therefore, that more intensive Soviet efforts in the production, fabrication, and utilization of titanium will follow acceptance of the metal by designers of Soviet military equipment, particularly aircraft.

I. Introduction.

The purpose of this memorandum is to assess the current status and future industrial potential of titanium* in the Sino-Soviet Bloc, especially in the USSR. Although numerous scientific and technical books and articles on titanium have been published in the Bloc, they indicate no spectacular advances in the knowledge of titanium metallurgy. These publications clearly indicate, however, that the USSR is well aware of the potential significance of the metal.

A brief review of the properties, applications, and limitations of titanium may be helpful in understanding why such great stress, unprecedented in the history of the development of a new metal, is being applied to the titanium industry in Free World countries. It will also help to explain why the progress of the titanium industry is being so carefully observed by the Bloc.

* The titanium pigment and ferroalloy industries will be mentioned only as they affect the production of the metal and titanium base alloys.

A. Properties and Uses of Titanium.

The unique properties of titanium that account in large measure for the tremendous interest in the metal and its principal alloys are its high strength-to-weight relationship, its retention of this and other desirable properties at high temperatures,* and its great resistance to chemical corrosion. For example, titanium alloys at normal temperatures have a tensile strength equal to high-strength steel alloys, but the titanium alloys weigh only one-half as much as equal volumes of the steel alloys. Although titanium alloys weigh twice as much as equal volumes of aluminum alloys, they have far greater tensile and impact strength. Some titanium alloys, moreover, retain useful structural properties at temperatures exceeding 800° F, which is considerably above the service limits of most aluminum alloys.

One of the more important Free World applications of titanium is that in the aircraft industry. In jet engines** and elsewhere in aircraft, titanium has displaced some stainless steel. In such instances the apparently higher cost of titanium components is offset by resultant reductions in aircraft structural weight. 3/ Similar weight savings are achieved by using titanium in such applications as skins and stiffeners, firewalls, exhaust shrouds, engine mounts, landing gear, spars, and other support members. The merit of titanium for aircraft use is clearly indicated by the fact that the production of Pratt and Whitney J-57 jet engines in 1957 will require several million pounds of titanium. Advanced models of many other jet engines will rely almost exclusively on titanium compressors. 4/

* Promising titanium-base alloys under development may increase the present 850° F maximum permissible operating temperature of titanium components to 1,100° F. 1/ (For serially numbered source references, see the Appendix.)

** Titanium alloys can be used effectively at temperatures between 300° F and 750° F, mainly in the compressor end of jet engines designed for speeds of Mach 2, and also for blades, discs, rings, spacers, casings, and bearing supports. 2/

B. Status of the Titanium Industry in the Free World.

All segments of the titanium industry, from production of sponge* and ingots through fabrication and utilization, have advanced considerably beyond the pilot-plant stage -- to what might be designated as a "semicommercial level" -- in less than 15 years. The first year in which titanium sponge was commercially produced in the US was 1948, when production was less than 10 tons for the entire year. 5/ By 1955, US production had expanded to 6,530 tons, 6/ Japan produced 1,475 tons, 7/ and the UK produced about 450 tons. Laboratory plants and small-scale pilot plants were operating in Canada, West Germany, Austria, France, and Italy during 1955, but their combined output was negligible. Free World production in 1955 was, therefore, about 8,700 tons. In 1956 the Free World probably will produce slightly more than 16,000 tons, 13,000 tons of which will be from the US alone.

The melting of titanium sponge into ingot, pioneered and largely developed by US industry, has attained a stage of technological development adequate for both present and foreseeable future needs. For example, equipment for the casting of ingots of 26-inch diameter weighing about 3 tons is in regular production, and provisions have been made for casting of 30-inch ingots weighing 4.5 tons. 8/ Although titanium melting equipment of the sizes mentioned has not been reported in use in Europe, US technology and equipment are generally available to most Free World countries. Presumably, such equipment will be installed when demands for the metal warrant installation; European concerns are certainly capable of manufacturing their own equipment. Until recently, technological problems made extensive fabrication of titanium metal impractical, and the bulk of the sponge produced went to the strategic stockpile. Although this same situation may prevail during 1957, the wide gap between the sponge produced and metal fabrication will surely be greatly reduced, if not eliminated, in the near future.

* Sponge is the industrial designation of the hard, porous, crude titanium metal resulting from the reduction of a titanium compound (usually titanium tetrachloride) by a reductant (usually magnesium or sodium). Sponge metal is consolidated into ingot form by melting under vacuum or inert atmosphere.

C. Outlook for the Titanium Industry in the US.

Both short-range and long-range prospects for the US titanium industry are good. Production of titanium sponge is increasing so rapidly that it is difficult to determine accurately either production rates or national capacity. By the end of 1956, sponge capacity probably will range between 24,000 and 25,000 tons. Increases authorized at existing works are expected to bring the aggregate annual capacity to more than 32,000 tons by 1958. Some of the strongest and most conservatively managed industrial concerns in the US are increasing their already huge investments in titanium production and fabricating facilities.

In brief, titanium is rapidly finding its special field of application in the most highly industrialized countries of the Free World. Contrary to much of the current publicity, titanium is not a panacea. It is, however, here to stay. A leading US metallurgist has aptly stated, "Where the combination of minimum weight and service in the temperature range of 300 - 800 deg. F. is required, titanium has no competition." 9/

II. Titanium in the USSR.

A. Development, Technology, and Production.

1. Evidence of Interest.

Soviet interest in titanium dates back at least 25 years. Production of high-titanium iron, ferrotitanium, and titanium pigments from domestic ilmenite* ores was the main objective. More recently, Soviet scientists have also published numerous books and articles indicating a substantial research program on both the physical metallurgy of titanium and on the various methods for producing the metal. [redacted] In addition, the Sixth Five Year Plan specifically states that by 1960 "prospected" titanium deposits must be increased 40 to 45 percent in comparison with deposits available at the beginning of the Plan period. 11/

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25X1X7

25X1X7

* Ilmenite is described on p. 9 , below.

2. Sponge Production Processes.

There is no indication that the USSR has developed processes for producing low Brinell hardness number (Bhn),* low-carbon titanium sponge, which in any way is comparable to that produced from magnesium or sodium reduction processes in common use in the Free World. Early Soviet efforts to produce metal by the hydride, iodide, and electrolytic processes apparently proved to be commercially impractical. The latest information available indicates that the USSR has adopted, with little or no modification, the Kroll-Wartman magnesium reduction process for producing ductile sponge, which is a process developed in the US. 12/

3. Ingot Melting and Ingot Size.

As in sponge production, scrutiny of available Soviet technical literature on methods and equipment for titanium ingot melting indicates no significant departures from Western practice. In fact, Soviet publications reveal that Free World methods for melting sponge and scrap into ingots are being checked in Soviet laboratories and probably are being adapted to Soviet needs. A recently published article in the Soviet press by the well-known Soviet metallurgist G. Mikhaylov traced the course of titanium development from ingot melting in a graphite crucible, then in copper-lined water-jacketed ones, and finally the switch from tungsten electrodes to consumable electrodes in vacuum-arc furnaces.** 13/ The only positive information on ingot size was a reference to a 25-kilogram (kg) ingot that was produced experimentally in the laboratories of the All-Union Scientific Research Institute for New Materials, 14/ which may be primarily responsible for titanium research and development. Mikhaylov stated that there was no interest in the small-size ingot, from which it can be inferred that production of "large ingots" has been mastered, at least in sufficient quantity to satisfy needs for experimentation. The source of the sponge is left in doubt, but it is presumably of domestic origin. Particular attention was also given to Soviet success in producing a consumable titanium electrode by pressing a combination of titanium shavings and titanium sponge. The largest consumable electrode produced thus far was indicated to be

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* Brinell hardness number 150 and lower, usually associated with commercially pure, ductile titanium sponge.

** Mikhaylov's account undoubtedly was based on published US technology.

[redacted]

just over 3 inches in diameter, whereas electrodes up to 26 inches in diameter are being produced in the US. 15/

4. Fabrication Technology.

Although information on production of sponge and ingots has been published in the Soviet press there is no evidence of serious Soviet efforts to develop the industrial technology of titanium fabrication or of activity comparable in any way to the intensive, industry-wide efforts of the US in developing mechanical working, welding, heat treating, or other techniques. It appears, however, that attempts are being made to roll titanium on a mill scale and that the quality and quantity of available sponge and ingots justify fairly large-scale experiments. Mikhaylov mentioned the necessity of rolling "huge ingots" and implied that experience gained in rolling small ingots could be applied to the rolling of large ingots. He may have been referring to an operation that took place at the Serp i Molot steel plant in Moscow in May 1956, when mill operators were reported to have achieved the first production of "rolled shaped profile" from titanium. 16/ The same report also claimed that Soviet industry was making wider use of titanium.

In view of the accessibility of most of the Free World's titanium technology, there is no reason to doubt that the USSR could produce and fabricate commercially pure titanium and titanium base alloys. At present, however, whether the USSR is in fact doing so is speculative; there is no confirmatory evidence to show that titanium base alloys of good properties and consistent quality are available in commercial tonnages. Quantity production and fabrication of titanium base alloys were developed in the US only after many years of the most concentrated development campaign in metallurgical history.

5. Physical Metallurgy and Alloy Development.

Recent Soviet reports of research on the physical metallurgy of titanium suggest that it is from 2 to 4 years behind that of the US. For example, a Soviet metallurgist, when asked in May 1956 what methods the USSR was using to melt sponge, replied that the most commonly used method was induction melting. 17/ In 1955, two papers written by competent Soviet authorities disclosed that melting was done in graphite crucibles and that the resultant material contained 0.8 percent carbon. 18/ A technical journal published by the USSR

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in September 1956 contained the statement that hot mechanical working of industrial titanium containing even a considerable amount (0.8 percent) of carbon did not present particular difficulties. 19/ Free World experience has shown clearly that a carbon content of 0.8 percent is far in excess of maximum allowances for quality products and that the industrial use of induction melting is impracticable because of the high carbon pickup.* 20/

B. Current Trends in Technology and Evidence of Production.

Statements of Soviet scientists and metal technicians indicate that such titanium sponge as is being produced in the USSR is made by the Kroll-Wartman magnesium reduction process. Production of titanium tetrachloride, required for the Kroll-Wartman process, from local raw materials is feasible; and the chemistry and methods for producing and purifying tetrachloride have been widely publicized in the Soviet press. There is also evidence which indicates that in the early 1950's the USSR was experimenting with a sodium reduction process, but there is no information to indicate the outcome of those experiments. 21/

There is little information on the quantities of titanium produced annually in the USSR, and Free World estimates of Soviet output have ranged from negligible to 95,000 tons per year.** On the basis of the qualitative information given in the numerous Soviet articles on titanium published in the Russian language, it can be inferred that titanium sponge probably is being produced domestically in sufficient quantities to sustain experimental production of ingots of comparatively small size (perhaps as large as 1,000 pounds). 22/ On an annual basis, this output in 1955 and perhaps even in 1956 probably was less than 5,000 tons and may very well have been only about 3,000 tons. If the USSR is indeed producing a significantly larger tonnage of titanium sponge than this, which is highly doubtful in view of Soviet published statements on titanium research and development,

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* Recent experiments on close control of melting time and temperature in induction melting in graphite have reduced contamination to a low (0.03 to 0.08 percent) figure. This work may lead to greater use of induction melting.

** The latter figure, widely circulated in the Free World press in late 1955 and early 1956, originated with a US newsman who misinterpreted an estimate of titanium ore reserves in the USSR obtained from an unidentified source in the US Government.

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Soviet officials are being modest to a degree unparalleled in the history of industrial development in the USSR.

C. Raw Material Base.

The abundant authentic information on the geology of the USSR indicates clearly that the nation has adequate natural resources to support a large-scale titanium industry. Although the USSR has only limited deposits of rutile, the only low-cost titanium mineral used for making titanium metal, it has extensive deposits of low-grade titanium-bearing ores. The main resources are the titaniferous magnetites in the Ilmen Mountains, a branch of the Urals. It is from these mountains that the mineral "ilmenite" received its name. These deposits were reported in 1938 to constitute a reserve of 400 million tons of ore. The ores, which contain 14 percent titanium dioxide, 54 percent iron, and 0.6 percent vanadium pentoxide, are amenable to magnetic separation. The concentrate so obtained contains 42 percent titanium dioxide and 37 percent iron. 23/

There are other important deposits of ilmenite on the Kola Peninsula. In 1950 the Africanda mine, the region's largest producer, had an estimated reserve of 50 million tons of ore containing 10 to 15 percent titanium dioxide. 24/ Titanium dioxide is also contained in the apatite* ores of the Kola Peninsula, which are being mined by the Kirovsk Apatite Combine, a producer of mineral fertilizer.

Although the USSR has an abundance of titanium-bearing ores, most of them are low in grade, by Free World standards, and require beneficiation. The resulting concentrates are satisfactory for the production of ferrotitanium, titanium-rich slags (72 to 75 percent titanium dioxide), and pigments, but they are not particularly desirable for economic manufacture of titanium tetrachloride, the industrial chemical source of titanium which is vital to both the magnesium and the sodium reduction processes. These processes are now the only ones that yield a commercially satisfactory ductile titanium sponge. The most advantageous and economic raw material for the production of titanium tetrachloride is rutile, which is reported to occur in the USSR only in the remote Kyzyl Kum area. 25/

Other raw materials needed in the Kroll-Wartman process (or its sodium variation) include, of course, magnesium or sodium reductants,

* Calcium fluorophosphate.

chlorine for the production of titanium tetrachloride, inert gases such as helium and argon, carbon, electric energy, and minor quantities of a few common materials. All of these are available in adequate supply in the USSR.

D. Utilization.

1. Aircraft Industry.

Recently produced Soviet aircraft and parts of such aircraft have not been available for examination in the US or elsewhere in the Free World, and concrete evidence of Soviet application of titanium in aircraft is not available. Although the extent to which Soviet aircraft contain titanium is uncertain, 26/ there is no doubt that Soviet aircraft engine designers have carefully considered using titanium in gas turbine engine compressor discs and blades and are well aware of titanium's potentialities in other applications. 27/ For example, they are known to have compared the properties of a titanium-aluminum-chromium alloy, corresponding to one developed by the Mallory-Sharron Titanium Corporation, with other light-metal alloys and steel. After comparing the weight savings and relative costs of titanium and steel, Soviet officials stated that "as titanium alloys are mastered and they are more extensively produced, we can expect a reduction in cost, both of the material itself and of parts made from it." 28/

2. Civilian Applications.

No quantitative or qualitative data on civilian applications of titanium and titanium base alloys in the USSR are now available. Several popular articles in the Soviet press have stressed the value of titanium in such nonmilitary applications as corrosion-resistant pipe and pipe fittings, fasteners, and electronics. Such limited information does not justify estimates of the quantities so used.

III. Titanium in the European Satellites and Communist China.

A. Hungary.

Hungary has shown considerable interest in titanium, particularly in recent years. 29/ Although the Hungarians have published several scholarly reports on titanium technology, the reports are based exclusively on Free World developments. 30/

Having no workable deposits of titanium ore, Hungary has confined laboratory experimental work primarily to efforts to extract the metal from the "red mud" produced as a residue in the manufacture of alumina, one of Hungary's major industries. Hungarian red mud residue may contain 5 to 6 percent titanium dioxide and other values in iron, vanadium, alumina, and caustic soda. On further chemical processing, and finally thermal reduction of the iron to pig, a titanium slag containing about 22 percent titanium dioxide can be produced, and then titanium can be extracted by chemical means. The economy of such involved processing of a low-grade residue depends on the recovery of not only the titanium, iron, and vanadium but also a good part of the alumina and chemicals contained in the red mud. A recent Budapest press report claimed that experimental production of titanium would be started by a Hungarian alumina plant and that large-scale production of titanium would be attained by the end of the Second Five Year Plan (1956-60). 31/ If this is true, Hungary could, perhaps, supply domestic needs.

B. East Germany.

In East Germany, research on various phases of titanium production processes, on bench and small pilot-plant scales, has been carried on intermittently since World War II at Elektrochemisches Kombinat Bitterfeld (EKB) and other East German research centers. The early work on titanium reportedly was on the Soviet account. Work in 1955, especially at EKB, has sought methods for recovering titanium from low-grade titanium-bearing materials from domestic sources, such as brown coal ashes, Baltic Sea black sands, and red mud residues from alumina plants.

EKB, the main center of titanium research, has been concerned mostly with the production of pure titanium tetrachloride as a base for the production of titanium sponge. Small-scale (about 6 kg per furnace run) experiments have also resulted in the production of some good sponge by means of the Kroll-Wartman magnesium reduction process. Experimental melting of sponge into ingot was scheduled for the latter part of 1955. 32/ As late as July 1956, however, little success had been achieved "insofar as economic production of the metal /titanium/ is concerned." 33/

Like Hungary, East Germany has no favorable natural-ore source of titanium and is unlikely to develop a sizable industry based on domestic materials. Any country with a titanium pigment industry, of

course, could use high-priced* anatase (titanium-dioxide pigment) as a source. Occasional reports of industrial-scale production of titanium from this material in East Germany cannot be verified.

C. Other European Satellites and Communist China.

Czechoslovakia, Poland, and Communist China are known to be interested in titanium, and on several occasions officials of those countries have referred to titanium as "the metal of the future." The scarcity of raw material resources in those countries indicates that in none of them has titanium production gone beyond laboratory experimental work.

Little is known about efforts in other European Satellites, but it is fairly safe to assume that research on some phases of titanium production and fabrication is in progress in most of them.

* The US price of anatase per pound of titanium content is about 40 cents, compared with ilmenite concentrate at 3 cents and titanium slag at 4 cents. 34/

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APPENDIX

SOURCE REFERENCES

Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
Doc. - Documentary	1 - Confirmed by other sources
A - Completely reliable	2 - Probably true
B - Usually reliable	3 - Possibly true
C - Fairly reliable	4 - Doubtful
D - Not usually reliable	5 - Probably false
E - Not reliable	6 - Cannot be judged
F - Cannot be judged	

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this memorandum. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

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1. *American Metal Market*, 1 Sep 56. U. Eval. RR 2.
2. Wile, George. *Use of Titanium in Jet Engines*, Lecture no 18, New York University, Titanium Metallurgy Course, 10-14 Sep 56. U. Eval. RR 2.
   American Metal Market, 9 Feb 56. U. Eval. RR 2.
3. Wile, *op. cit.* (2, above).
   American Metal Market, 1 Sep 56. U. Eval. RR 2.

[redacted]

[redacted]

4. Kaufmann, D.W. General Applications of Titanium, Lecture no 20, New York University, Titanium Metallurgy Course, 10-14 Sep 56. U. Eval. RR 1.
5. Interior, Bureau of Mines. Mineral Industry Surveys: Titanium in 1955 (Preliminary), MS no 2454, 3 Jan 56, p. 2. U. Eval. RR 2.
6. Ibid.
7. Japan, Titanium Society. Titanium, Tokyo, 1956. U. Eval. RR 2.
8. Modern Metals, Sep 56, p. 40. U. Eval. RR 2.
Machinery, 13 Jul 56. U. Eval. RR 2.
9. Kellogg, H.H. "What the Future Holds for Titanium," Engineering and Mining Journal, vol 156, no 4, Apr 55, p. 72-84. U. Eval. RR 2.
10. [redacted]
11. [redacted]
12. Air, AIIR. IR-636-56, 1 Jun 56, info 18 May 56, p. 2. C. Eval. RR 2.
CIA. OO, 31 Oct 56. S. Eval. RR 2.
13. CIA. FDD Special Translation no S-920, 26 Jul 56. OFF USE. Eval. RR 2.
14. Ibid.
15. Modern Metals, Sep 56, p. 40. U. Eval. RR 2.
16. [redacted]
17. Air, AIRR. IR-636-56, 1 Jun 56, info 18 May 56, p. 2. C. Eval. RR 2.
18. CIA. OO, 1 May 56. C. Eval. RR 3.
19. CIA. FDD Summary no 1125, 12 Nov 56, Data on USSR Extractive Industries (16), p. 44. OFF USE. Eval. RR 3.
20. Feild, A.L., Jr. "Expendable Molds for Titanium Casting," Metal Progress, Oct 56, p. 95-96. U. Eval. RR 2.
21. CIA. OO, 12 Jul 56. C. Eval. RR 3.
22. CIA. FDD Special Translation no S-920, 26 Jul 56. OFF USE. Eval. RR 2.
CIA. OO, Sep 56, info summer 56. C. Eval. RR 3.
23. Barksdale, Jelks. Titanium, New York, 1949, p. 22. U. Eval. RR 2.
24. CIA. FDD Q-630, 4 Feb 53, info 1950, p. 15. S. Eval. RR 3.
25. Barksdale, op. cit. (23, above), p. 32. U. Eval. RR 2.

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26. CIA. OO, 31 Oct 56. S/NOFORN. Eval. RR 3.
27. [redacted]
CIA. FDD Special Translation no S-1425, 26 Jun 56. U. Eval. RR 3.
CIA. 00-M-422, 6 May 55. OFF USE. Eval. RR 2.

25X1X7

28. [redacted]
29. Air, AIIR. IR-1313-56, 27 Apr 56. U. Eval. RR 3.
30. CIA. FDD U-9081, 25 Oct 56. OFF USE. Eval. RR 2. (tr of Laszlo Gillemot. Kohaszati lapok, vol 10, no 12, Budapest, Dec 55, p. 548-553. U)
31. Air, AIIR. IR-9343-56, 13 Aug 56. C. Eval. RR 2.
32. Air, AIIR. IR-460-56, 17 Apr 56, p. 10. C. Eval. RR 3.
33. Air, AIIR. IR-1851-56, 24 Jul 56. S. Eval. RR 3.
34. Kellogg, op. cit. (9, above), p. 75. U. Eval. RR 2.

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7	Air Force, Director of Intelligence, Rm. 4B137, Att: 1B1-D
25X9A8	[redacted]
5	
3	Assistant Secretary of Defense, International Security Affairs, Room 2E860, Pentagon
1	Assistant Secretary of Defense, Research and Development, Room 3E1048, Pentagon
1	National War College, Fort Lesley J. McNair
25X9A8	[redacted])
	~~1 Mr. Edward J. Gerald, USIA, RI/C, Room 811~~
25X1A9a	[redacted] ~~Washington 25, DC~~
	[redacted] ~~on 443, 1717 H St. (China only)~~
10	[redacted] Office of DD/I, 353 Adm. Bldg.

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20 December 1956

MEMORANDUM FOR: Assistant Director, Research and Reports

FROM : Chief, Projects Control Staff

SUBJECT : Dissemination of CIA/RR IM-443, Titanium in the Sino-Soviet Bloc, (Secret), (Project 24.1649)

1. It is recommended that subject report be issued as an Intelligence Memorandum and that it be given standard dissemination for ORR finished intelligence reports.

2. The action division for this project is Materials Division, Non-Ferrous Metals and Minerals Branch. The Chief, Economic Research, has read and approved this draft.

3. Attached are (1) a final typed copy of IM-443 to be used for reproduction, and (2) recommended dissemination lists for subject report.

25X1A9a [redacted]

25X1A9a

Attachments:
As indicated

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Approved [redacted] Dec. [redacted], who [redacted] 2 copies go to [redacted] will prepare memo to Arthur Fleming for DD/I's signature.

OEG

25X1A9a

[redacted] may have additional instructions

~~SECRET~~

ER 8-9436

5 January 1957

The Honorable Arthur S. Flemming
The Director, Office of Defense Mobilization
Executive Office Building
Washington, D. C.

Dear Arthur:

In accord with my promise to supply you with a study on titanium in the Sino-Soviet Bloc, I am enclosing the completed work in five copies. Additional copies are available if you require them.

As I have mentioned in previous correspondence (25 May 1956 and 4 August 1956) on this subject, our information is sparse on titanium. The multiple security walls surrounding the research, development and utilization of titanium in the Soviet Union make our assessment of the situation most difficult.

If, after you and your people have examined the study, you have questions or desire further evaluation, I invite you to communicate directly with Dr. Otto E. Guthe, Assistant Director for Research and Reports.

Faithfully,

Allen W. Dulles
Director

Attachments
IM-443 (#162-166)

ODDI:[redacted]jb 25X1A9a

CONCUR: ______________________
Deputy Director/Intelligence

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Supplementary Source References

TITANIUM IN THE SINO-SOIVET BLOC

CIA/RR IM-443

31 December 1956

WARNING

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, USC, SECS. 793 AND 794, THE TRANSMISSION OR REVELATION OF WHICH IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

CENTRAL INTELLIGENCE AGENCY

Office of Research and Reports

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Approved For Release 1999/09/21 : CIA-RDP79T00935A000400200001-8

CIA/RR IM-443
(ORR Project 24.1649

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Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
Doc. - Documentary	1 - Confirmed by other sources
A - Completely reliable	2 - Probably true
B - Usually reliable	3 - Possibly true
C - Fairly reliable	4 - Doubtful
D - Not usually reliable	5 - Probably false
E - Not reliable	6 - Cannot be judged
F - Cannot be judged	

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this memorandum. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

The source references listed below constitute only those from which identifying numbers have been deleted in the Source References appendix to the memorandum. Some of these references appear in the original memorandum together with other references in connection with the same citation

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[redacted]

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12. CIA. [redacted] 31 Oct 56. S/NOFORN. Eval. RR 3.

18. CIA. [redacted] 1 May 56. C. Eval. RR 3.

21. CIA. [redacted] 12 Jul 56. C. Eval. RR 3.

22. CIA. [redacted] Sep 56, info summer 56. C. Eval. RR 3.

26. CIA. [redacted] 31 Oct 56. S/NOFORN. Eval. RR 3.

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Supplementary Source References for

Series Number CIA/RR IM-443

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